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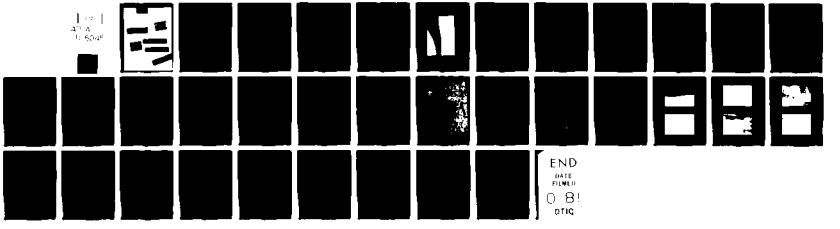

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Masters Lake Dam (MO 30065).
Upper Mississippi - Mississippi - Kaskaskia - St. Louis Basin. Dent County, Missouri.
Phase I Inspection Report.

(9) Final rept.,
(15) DACW 43-78-C-0169
(10) Ervin H. /Baumeyer Lutz /Kunze

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4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Masters Dam (MO 30065) Dent County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report 6. PERFORMING ORG. REPORT NUMBER
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Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Masters Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Masters Lake Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

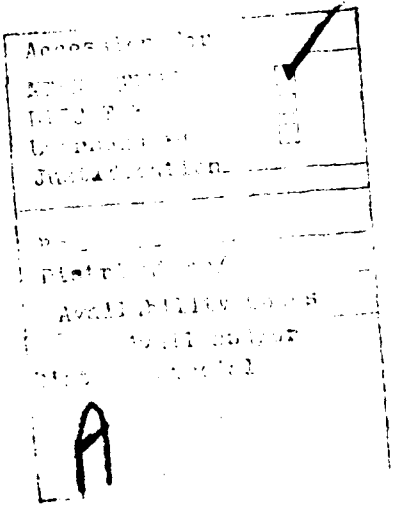
1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED
Chief, Engineering Division

23 FEB 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

23 FEB 1979
Date



PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Masters Lake
State Located	Missouri
County Located	Dent County
Stream	Tributary To Loss Creek
Date of Inspection	September 26, 1978

Masters Lake Dam, No. 30065 was inspected using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U. S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Masters Lake Dam was visually inspected by an interdisciplinary team of engineers from Kenneth Balk & Associates, Inc. and Shannon & Wilson, Inc. The purpose of the inspection was to make a preliminary assessment of the general condition of the dam with respect to safety in order to determine if, in the opinion of the interdisciplinary team, the dam poses recognizable hazards to human life or property. This assessment is based solely upon data made available and visual evidence observed during the site visit.

To make a complete assessment of the safety of the dam would require detailed studies and engineering analyses beyond the scope of this preliminary assessment.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The estimated damage zone extends six miles downstream of the dam. Within the damage zone are one house, two mobile homes, another lake and two improved roads. Masters Lake Dam is in the small size classification since it is greater than 25 feet high but less than 40 feet high.

The inspection and evaluation indicate that the spillway of Masters Lake does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Masters Lake is a small size dam with a high hazard potential, required by the guidelines to pass from one-half PMF to the PMF. Considering the high hazard potential to loss of life and property downstream of the dam, the outlet facilities of Masters Dam should be able to pass 50 percent of the PMF without overtopping the dam. However, it was determined that the spillway will only pass 5 percent of the PMF without overtopping the dam.

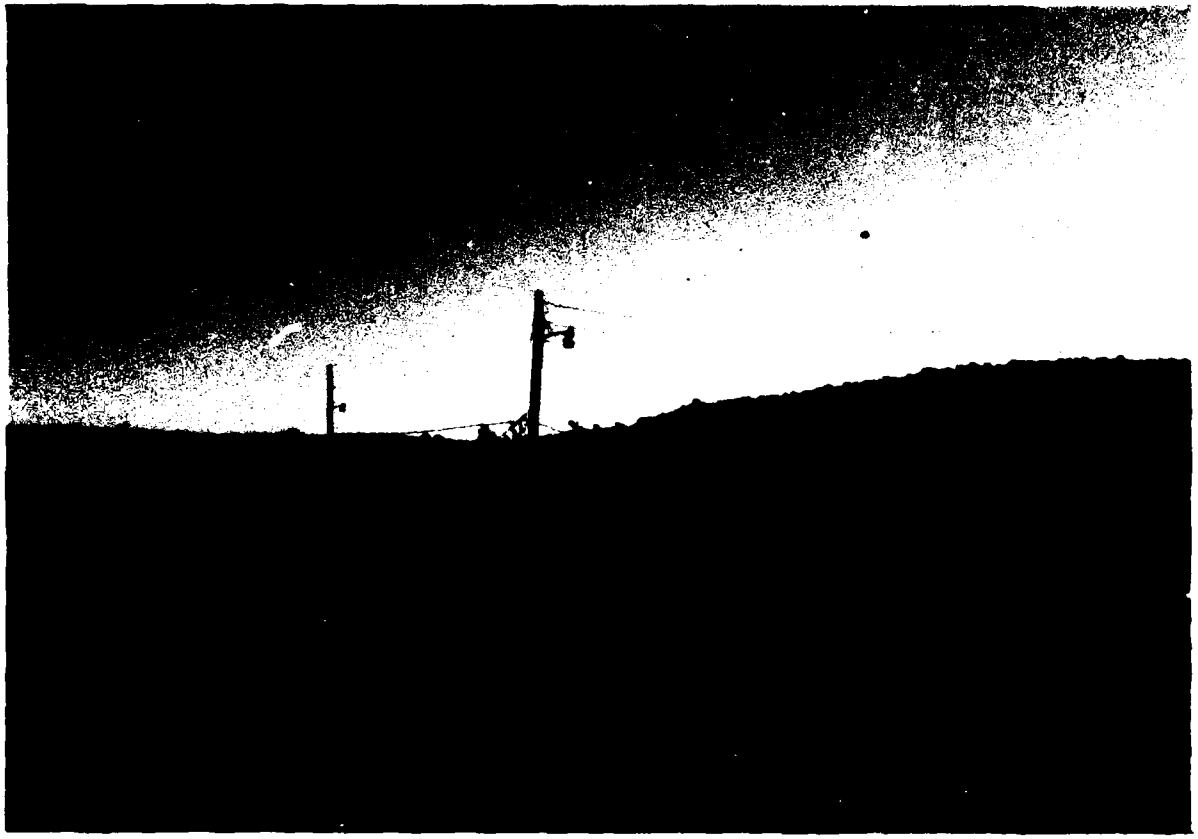
The evaluation of Masters Lake also indicated that the spillway will only pass 50 percent of the 100-year flood; the 100-year flood is defined as a flood having a 1 percent chance of being equalled or exceeded during any given year.

Deficiencies visually observed by the inspection team were some erosion in the emergency spillway outlet channel and small trees on the upstream slope of the embankment and in the entrance to the emergency spillway. Other deficiencies found were the lack of seepage records, operational records, seepage and stability analyses comparable to the Recommended Guidelines and seismic stability analyses.

We recommend that action be taken in the near future to correct or control the deficiencies described. A detailed report discussing each of these deficiencies is attached.

Ervin H. Baumeyer, P.E.
Principal-In-Charge
Kenneth Balk and Associates, Inc.
St. Louis, Missouri

Lutz Kunze, P.E.
Principal Engineer
Shannon & Wilson, Inc.
St. Louis, Missouri



Overview of Lake and Dam

MASTERS LAKE DAM

DENT COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30065

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY

Kenneth Balk & Associates, Inc.
St. Louis, Missouri
Shannon & Wilson, Inc.
St. Louis, Missouri

PREPARED FOR

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

NOVEMBER, 1978

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MASTERS DAM - ID NO. 30065

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Masters Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon data made available and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure built on Loss Creek in the northern part of Dent County, Missouri. Topography adjacent to the valley is rolling. Most of the area in the vicinity of the dam is covered with a residual soil overlying dolomite. Topography in the vicinity of the dam is shown on Plate 1.

(2) The principal spillway consists of a 36" C.M.P. in the right abutment (east end of dam).

(3) An emergency spillway is cut in residual soil on the left abutment (west end of the dam).

(4) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the northeastern portion of Dent County, Missouri, as shown on Plate 2. The lake formed by the dam is on the Missouri-Dent County Stone Hill quadrangle sheet in the SW 1/4 of Section 16, T35N, R5W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the Small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c. Based on referenced guidelines, the Corps of Engineers has determined that this dam is in the High Hazard Classification and thus has been selected by the Corps of Engineers for Phase I inspection.

e. Ownership. The dam is reportedly owned by Mr. Jack Masters, 1121 N. Main, Salem, Missouri 65560.

f. Purpose of Dam. The dam forms a recreational lake.

g. Design and Construction History. Some design data and construction records were available for review at the Soil Conservation Service office in Salem, Mo. The data consisted of design cross-section of the dam and several geologic reports. The construction of the dam was supervised by the SCS and was completed in 1962. The initial slope of the downstream face of the embankment was designed to be 2 H. to 1 V. which was later changed in the design stage to 3 H. to 1 V. The dam has a 10 foot wide upstream bench at approximately the waterline and a key trench which was constructed to rock. The 36 inch CMP that serves as principal spillway goes through the embankment and the design shows three seepage cut-off collars.

h. Normal Operating Procedure. No operating records were found. Outflow passes through uncontrolled spillways. Normal rainfall, spillway discharges, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 2,111 acres.

b. Discharge at Damsite.

(1) 36" C.M.P spillway - 87.8 cfs. at maximum pool.

(2) Emergency spillway - 483.0 cfs. at maximum pool.

(3) Estimated experienced maximum flood - approximately two feet below top of dam.

c. Elevation (U.S.G.S.)

(1) Top of dam - 1009.8± .

(2) Invert of 36" C.M.P. spillway - 1001.7±.

(3) Spillway Crest - 1001.7±.

(4) Streambed at Centerline of Dam - 980±.

(5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 2100 feet ±.

e. Storage (Acre-feet).

(1) Normal - 372

(2) Maximum - 722.8

f. Reservoir Surface (Acres).

(1) Top of dam - 51.

(2) Spillway crest - 32

g. Dam.

(1) Type - earth embankment.

(2) Length - 800 feet.

(3) Height - 30 feet maximum.

(4) Top width - 14 feet.

(5) Side Slopes - (Measured by slope meter/inclinometer in degrees and converted to ratios.)

(a) Downstream 2.75 H. to 1 V.

(b) Upstream - 2 H. to 1 V.

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - yes Reference to paragraph 1.2.g.

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel. - None.

i. Principal Spillway.

(1) Type - 36" C.M.P.

(2) Crest elevation - 1001.7 U.S.G.S.

j. Emergency Overflow Spillway

(1) Type - Earthen channel, generally trapezoidal in section.

(2) Invert at lakeside 1007.9 U.S.G.S.

k. Regulating Structure. An 8 inch diameter pipe with a valve, is located near the principal spillway.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Some design data were found to be available.

2.2 CONSTRUCTION

The dam was completed in 1962.

2.3 OPERATION

No records of the maximum loading on the dam were available.

2.4 EVALUATION

a. Availability. Some engineering or geological data consisting of one drawing depicting a cross-section of the dam, and a geological report of the vicinity of the dam were available and were utilized in the preparation of this report.

b. Adequacy. The engineering data available was not sufficient to make a detailed assessment of the design, construction, and operation. The lack of seepage and stability analyses comparable to the requirements of the Recommended Guidelines is considered a deficiency which should be corrected. An engineer experienced in the design of dams should be retained to perform detailed seepage and stability analyses.

c. Validity. The engineering and geological data available was considered valid.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General. A visual inspection of the Masters Dam was carried out on September 26, 1978. Personnel making the inspection were employees of Kenneth Balk and Associates, Inc. and Shannon and Wilson, Inc. of St. Louis and included civil, geotechnical, and structural engineers and an engineering geologist. Specific observations are discussed below.

B. Dam. The inspection team observed the following at the dam.

The dam is an earth structure with a hard-packed, unpaved road running over the crest. No detrimental settlement, seepage, depressions, cracking, animal burrows or slope instability was observed on or near the embankment.

Some small trees and brush are growing on the upstream slope and brush and high grass covers the downstream slope. Erosion protection on the upstream slope consists of a 10 foot wide bench at the waterline and a grass cover on the slope.

C. Appurtenant Structures. The principal spillway consists of a 36 inch CMP located in the embankment near the right abutment and it falls into a pool at the toe of the dam.

An emergency overflow spillway is cut in the left abutment and the outlet channel runs parallel to the toe of the dam. Some small trees and brush are growing in the inlet channel. Some erosion was observed in the outlet channel.

D. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore of the reservoir.

E. Damsite Geology.

The dam site is underlain by flat lying dolomites and dolomitic limestone of the Gasconade Formation. On the adjacent hillsides, the Gasconade Formation is overlain by a thick veneer of colluvium and in the narrow flood plain of Loss Creek by fine grained alluvial soils. No bedrock units were exposed beneath.

Right Abutment - On the right abutment, the upper part of the embankment can be observed in direct contact with the Gasconade bedrock units. Outcrops above the dam consist of a layered sequence of limestone and dolomite beds with bedding varying from six to eight inches with one massive three foot thick dolomite bed. The limestone dolomite sequence was gray to weathered tan, soft to hard with local

vuggy zones and chert lenses. Dip of beds was about 4 degrees due south. Joints were principally vertical and ranged in spacing from a few inches in the thin layers to two to three feet wide in the massive layer. The bedrock units observed appeared to be relatively impermeable.

Left Abutment - Bedrock units are not exposed on the left abutment in contact with the embankment. Colluvial soils can be observed adjacent to the embankment where they consist of angular rock fragments in a matrix of brown, clayey silt. It is estimated that the colluvial soils are probably on the order of three to five feet thick and overlie flat laying dolomite and limestone units.

3.2 EVALUATION

The trees, brush and other excessive vegetation is a potential seepage hazard and encourages wild life which may include burrowing animals. If left uncorrected the erosion in the emergency spillway outlet channel may endanger the integrity of the dam. The deficiencies noted may with time affect the dam's stability and should be corrected. The upstream erosion protection appears adequate for this dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The lake level is controlled by rainfall, runoff, evaporation, the capacity of uncontrolled spillways, and the regulating structure.

4.2 MAINTENANCE OF DAM

No maintenance records of the dam were available.

4.3 MAINTENANCE OF OPERATING FACILITIES

No maintenance records were available.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

In our opinion, a regular program of vegetation control and maintenance should be initiated. The trees and brush on the dam are deficiencies which should be corrected.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydrologic or hydraulic design data were made available.

b. Experience Data. The drainage area and lake surface area are developed from USGS Stone Hill Mo. Quadrangle. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations.

(1) The spillway (36" CMP) is located near the right or east abutment. Spillway discharge will not endanger the integrity of the dam.

(2) The overflow spillway is located at the left or west abutment. The outlet channel is located at the toe and parallel to it. Some trees are growing in spillway outlet channel. Spillway discharge may endanger the integrity of the dam.

d. Overtopping Potential. The principal and overflow spillways have been found to be inadequate to pass the Probable Maximum Flood (PMF) without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region.

For the PMF and one-half PMF, the dam would be overtopped to a maximum height of approximately 5.8 feet and 3.2 feet, with a duration of overtopping of approximately 14 hours and 11.2 hours, and a maximum discharge rate of 24549 cfs. and 10560 cfs. respectively. In our opinion, failure of the dam may be expected to occur as a result of overtopping for this length of time.

The spillways have been found to be adequate to pass a flood of approximately five percent (5%) of the PMF.

The spillways have been found to be inadequate to pass the 100-year flood, which has a 1% chance of being equalled or exceeded at least once during any given year.

The estimated damage zone extends six miles downstream of the dam. Within the damage zone are one house, two mobile homes, another lake and two improved roads.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visually observed conditions which can affect the structural stability of this dam have been discussed in Section 3.

b. Design and Construction Data. No design or construction data relating to the structural stability of the dam were found except that discussed in Section 1.2. The lack of seepage and stability analyses comparable to the requirements of the Recommended Guidelines is a deficiency which should be corrected.

c. Operating Records. No records were available at the time of the inspection.

d. Post-Construction Changes. No post-construction changes are apparent.

e. Seismic Stability. The location of Masters Dam is in Seismic Zone 1. The available engineering data was insufficient to evaluate the seismic stability of the dam, however, it is our opinion that an earthquake of the magnitude expected in this zone on a dam of this type and size would not cause a structural collapse of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Corrective measures should be taken for the deficiencies visually observed by the inspection team, i.e. growth of small trees and brush on the embankment and in the emergency spillway inlet channel and erosion in the emergency spillway outlet channel. Inadequate spillway capacities are also considered to be a deficiency.

b. Adequacy of Information. The conclusions of this report were based on the design data made available, performance and external visual conditions. The lack of seepage and stability analyses comparable to the requirements of the Recommended Guidelines is a deficiency which should be corrected. The inspection team considers that these data are sufficient to support the conclusions herein.

7.2 REMEDIAL MEASURES

a. O&M Procedures. The following O&M procedures are recommended:

(1) Trees and excessive vegetation should be removed from the upstream and downstream slopes and the emergency spillway inlet channel.

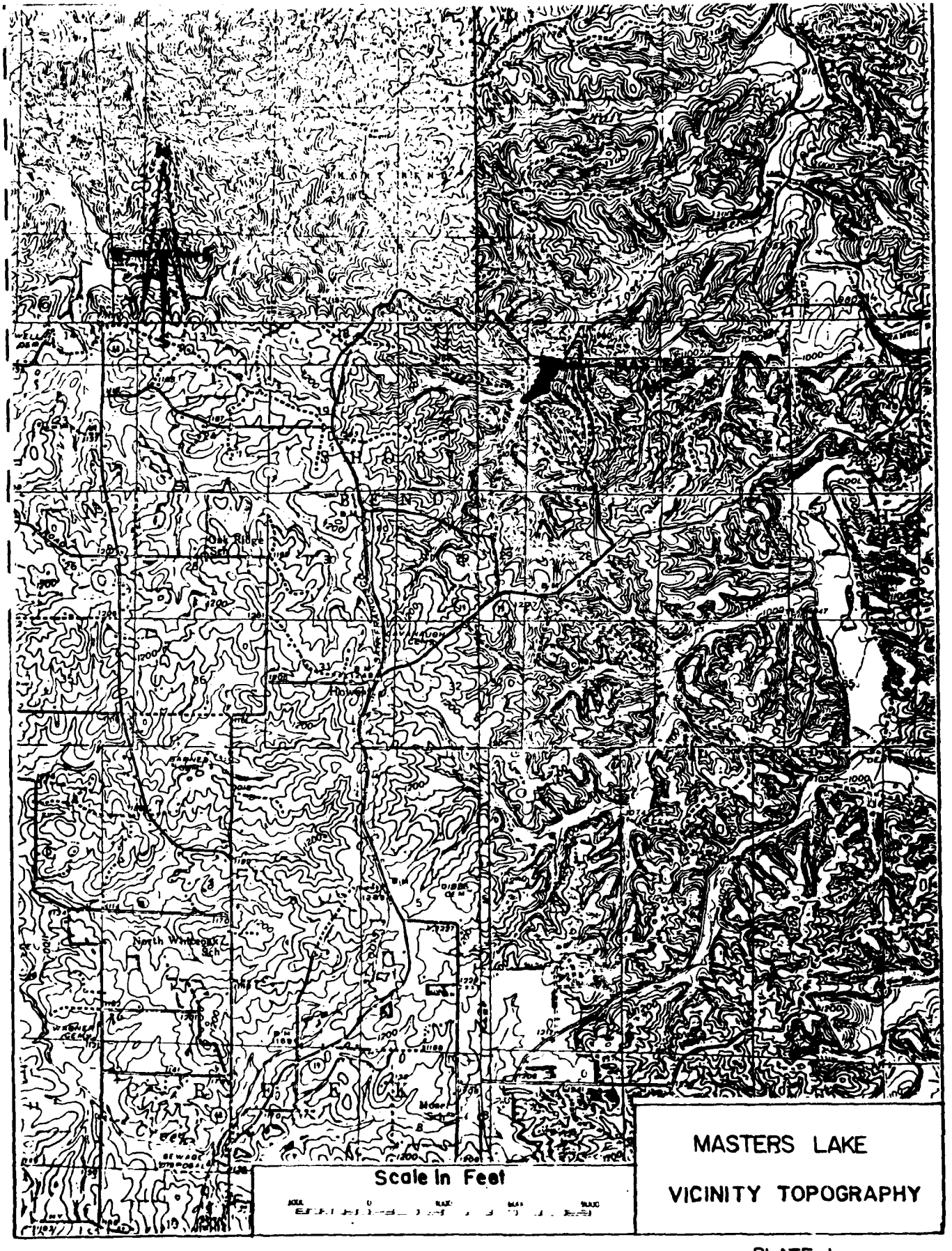
(2) The erosion in the outlet channel of the emergency spillway should be repaired.

(3) The owner should keep up-to-date records of all future maintenance and repairs.

(4) Spillway capacity and/or height of dam should be increased to pass 50 percent (50%) of the Probable Maximum Flood.

(5) The dam should be periodically inspected by an engineer experienced in the design and construction of dams.

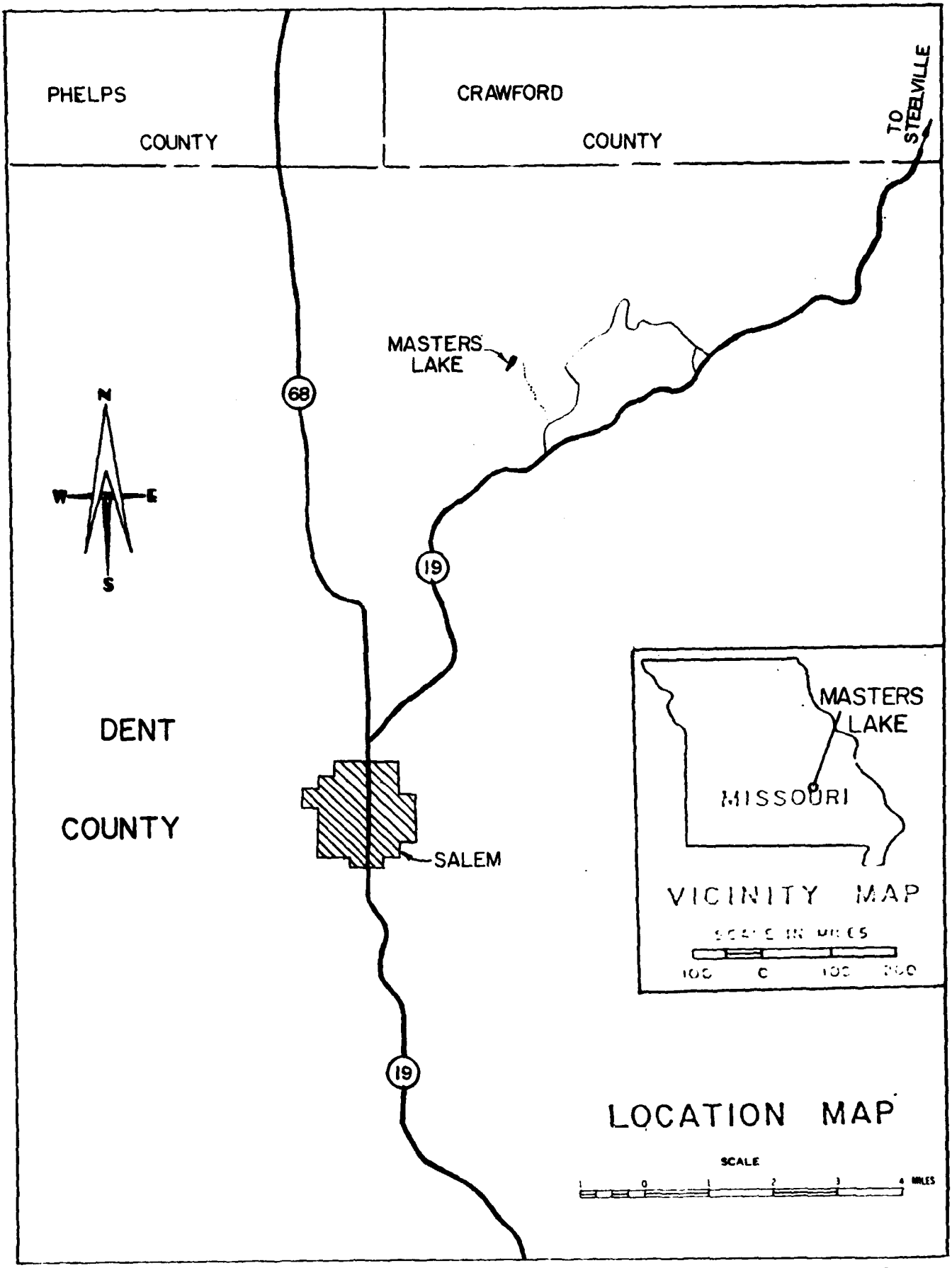
(6) Seepage and stability analyses comparable to the requirements of the Recommended Guidelines should be performed by an engineer experienced in the design of dams.



MASTERS LAKE

VICINITY TOPOGRAPHY

PLATE 1


PHELPS
COUNTY
CRAWFORD
COUNTY
TO STEELVILLE
MASTERS LAKE
68
19
N
W
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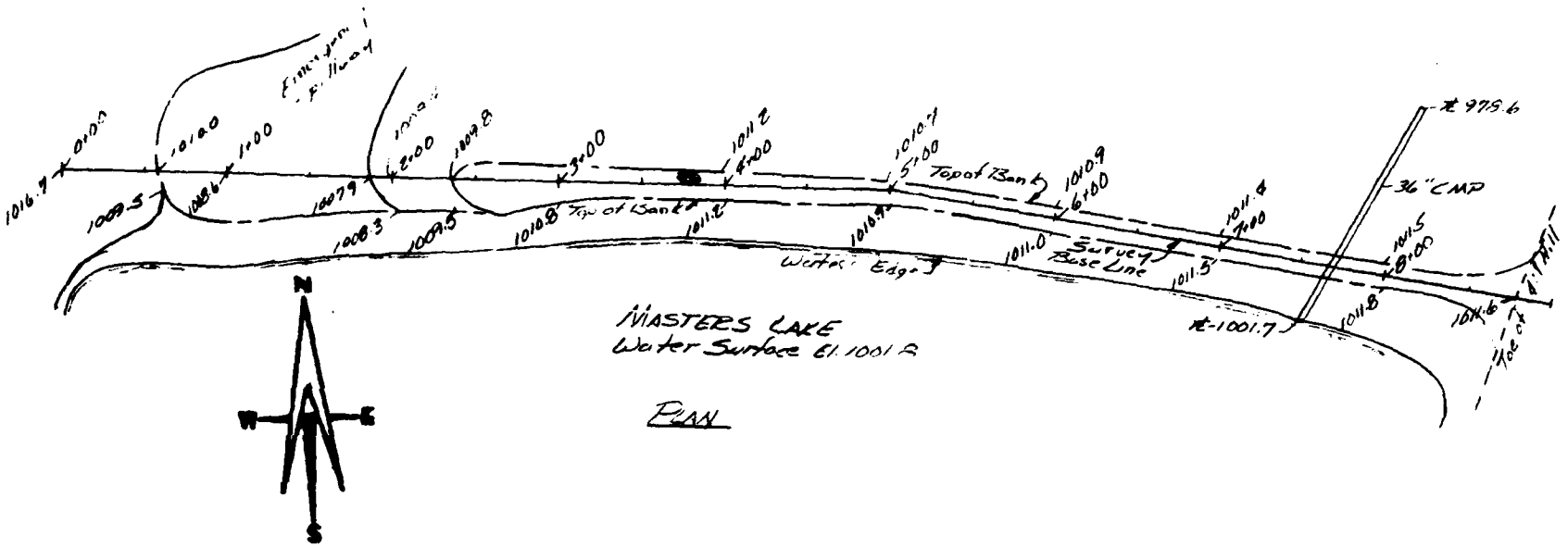
S
DENT
COUNTY
SALEM
19
MASTERS LAKE
MISSOURI
VICINITY MAP
SCALE IN MILES
LOCATION MAP
SCALE
0
1
2
3
4 MILES

PLATE 2



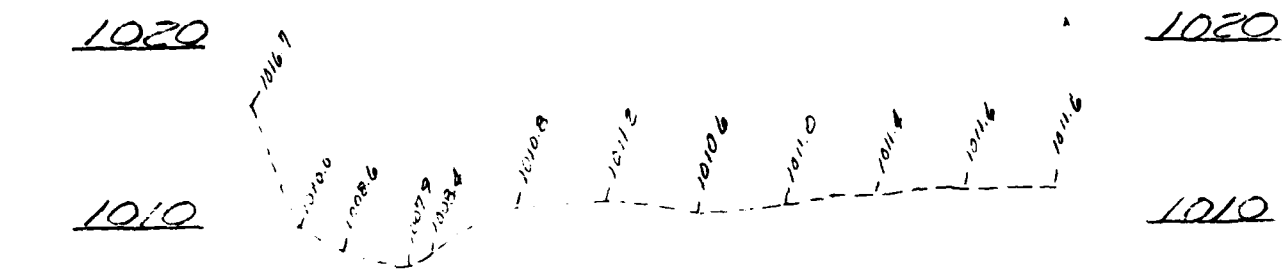
PLAN

MASTERS LAKE

TOP OF DAM ELEVATIONS

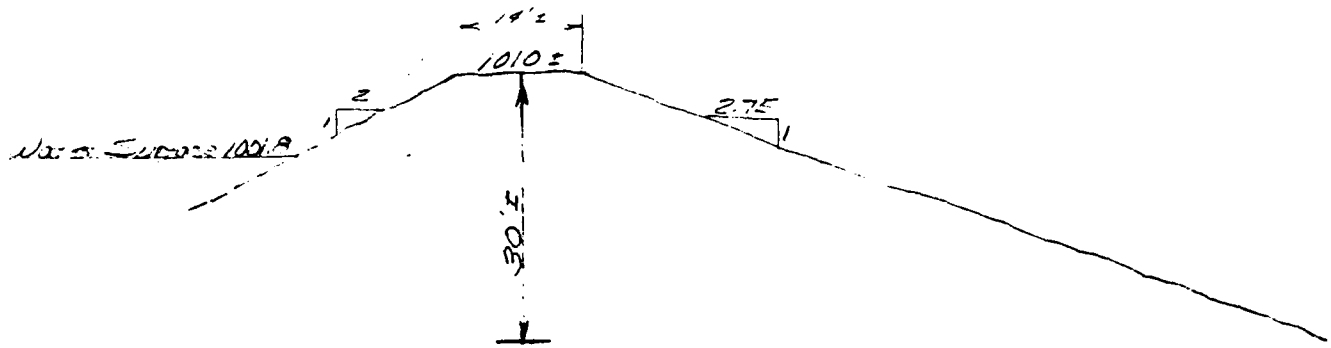
SCALE: 1"=100'±

PLATE 3



PROFILE

SCALE: 1"=20' H & 1"=10' V



TYPICAL CROSS SECTION

SCALE: 1"=20' H & V

MASTERS LAKE

DAM PROFILE
and CROSS SECTION

PLATE 4

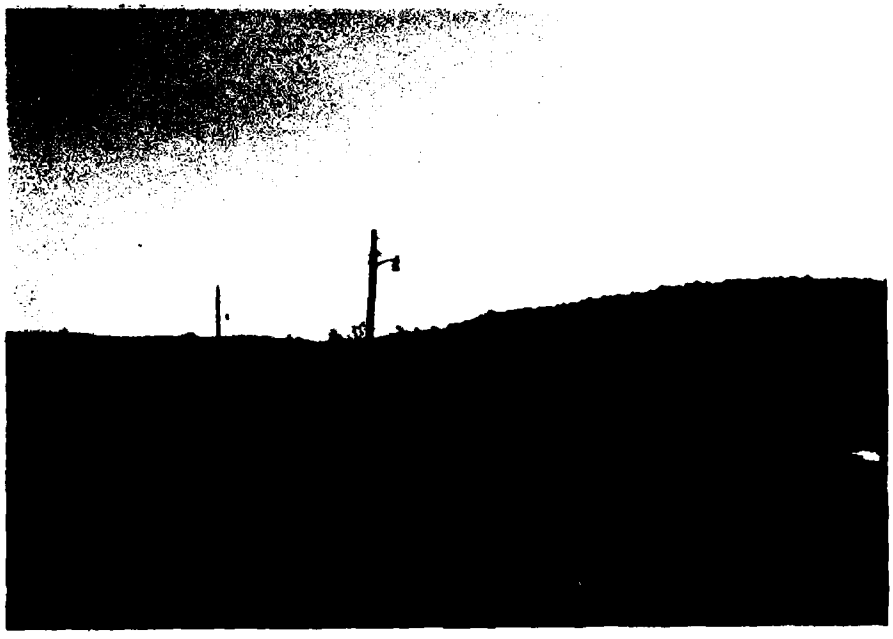


PHOTO 1 Overview of Lake and Dam

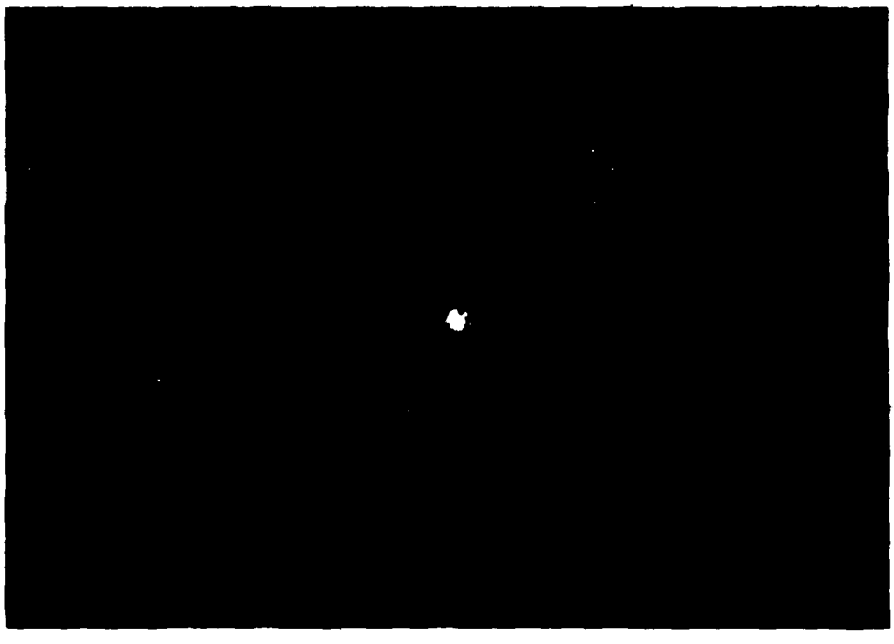


PHOTO 2 Crest of Dam

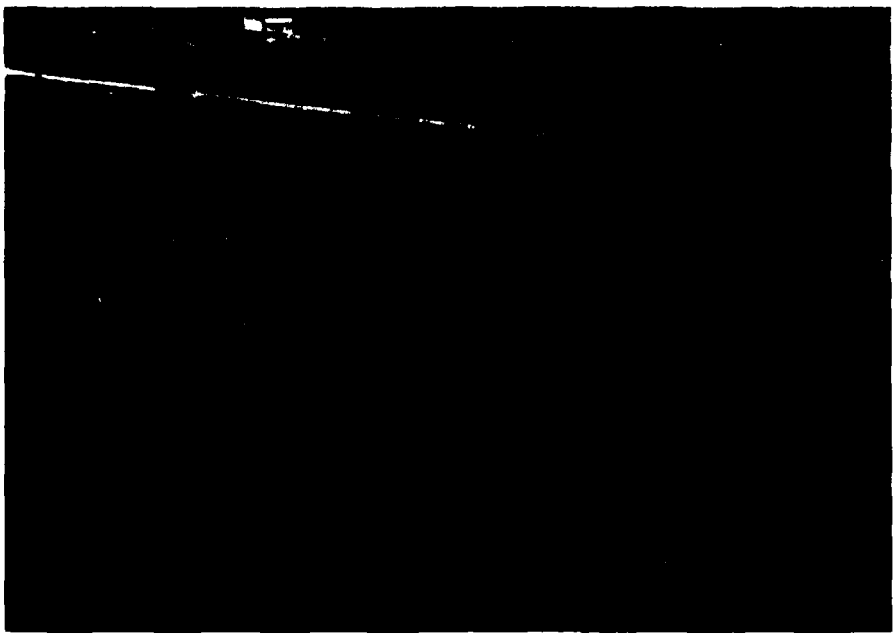


PHOTO 3 Principal Spillway Entrance

PHOTO 4 Principal Spillway Exit and Tailwater

PHOTO 5 Right Abutment Showing Rock Outcrop

PHOTO 6 View Westerly of Emergency Spillway Exit Channel (Dam is on Left)

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 24-hour storm duration is assumed with the total rainfall depth distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The nonpeak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by utilizing the Soil Conservation Service dimensionless unit hydrograph using Hydrologic Soils Groups "B" and "C", Antecedent Moisture Condition III, and SCS CN 83 used to determine rainfall excess.

Lag time was estimated using methods outlined in "Design of Small Dams", by the United States Department of The Interior, Bureau of Reclamation. Using this source, lag time is taken as 60% of the time of concentration.

Time of concentration was estimated utilizing methods outlined in the source quoted above, supplemented by data obtained during field investigation. The results of the field investigation and the computations indicated that a time of 35 minutes was appropriate. For this lake, a lag time of 0.35 hours was therefore selected.

2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the outlet works, spillway, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the outlet works, spillway, and top of dam are defined by elevation-discharge curves.

3. Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

Flow through the 36" CMP spillway was obtained by considering it as an orifice using the equation.

$$Q = CA\,(2gH)^{\frac{1}{2}}$$

Where:

C = Orifice coefficient, taken as 0.6

A = Area of 36" CMP

g = Acceleration due to gravity

H = Head in feet, varying with the lake water surface

Q = Discharge in cfs.

Flow through the overflow spillway and over the top of the dam was calculated using the weir flow equation:

$$Q = CL(H)^{1.5}$$

where: C = Varies with head as outlined in "Handbook of Hydraulics" by Horace Williams King, revised by Ernest F. Brater.

L = Length in feet (varies with water surface)

H = Head of water in feet (varies with water surface)

Q = Discharge in cfs

4. The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed in the attached computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

5. The inflow hydrograph was routed through the reservoir using HEC-1's Modified Puls option. Releases were calculated for: 1) the principal spillway, 2) the overflow spillway, and 3) the flow over the top of the dam. These releases were then combined at each of their respective elevations.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
    1  A1                    MASTERS LAKE MULTI-RESERVOIR ROUTING
    2  A2                                NOV.  1978
    3  A3                          MO. INV. NO. 30065
    4  B    288      -0       5      -0      -0      -0      -0      -0      -4      -0
    5  B1     5
    6  J      1       6       1
    7  J1   .10     .15     .20     .30     .50    1.00
    8  K      0  INFLOW                                3       1
    9  K1     SUBAREA  RUNOFF  FOR  LOSS  LAKE
   10  M      1       2    0.91                         1                       1
   11  P              26     100     120     130
   12  T                                                        -1     -83             .05
   13  W2           .35
   14  X   1.82     -.1       3
   15  K      1 ROUTING                                 2       2       1
   16  K1    RESERVOIR  ROUTING  FOR  LOSS  LAKE
   17  Y                                     1       1
   18  Y1     1                                                -1135.5      -1
   19  Y41135.5  1136.0  1136.5  1137.0  1137.5  1138.0  1138.5  1139.0  1139.5  1140.0
   20  Y41140.5  1141.0  1141.5  1142.0  1142.5  1143.0  1143.5  1144.0  1144.5
   21  Y5     0    4.26   15.85   36.06   63.04  106.37  152.86  226.95  294.85  375.06
   22  Y5468.49  572.80  793.25 2052.38 4071.13 6103.40 8150.0910214.0612290.51
   23  $S     0   40.04   80.64  121.81  163.52  205.80  248.64  292.04  336.00  380.52
   24  $S425.96  472.68  520.68  569.96  620.52  672.36  725.48  779.88  835.56
   25  $E1135.5  1136.0  1136.5  1137.0  1137.5  1138.0  1138.5  1139.0  1139.5  1140.0
   26  $E1140.5  1141.0  1141.5  1142.0  1142.5  1143.0  1143.5  1144.0  1144.5
   27  $$1135.5
   28  $D1141.2
   29  K      0  INFLOW                                3       1
   30  K1     SUBAREA  RUNOFF  FOR  MASTERS  LAKE
   31  M      1       2     3.3                         1                       1
   32  P              26     100     120     130
   33  T                                                        -1     -83             .04
   34  W2           .75
   35  X    6.6     -.1       3
   36  K      2                                       2       2       1
   37  K1     MASTERS AND LOSS  LAKES  HYDROGRAPHS  COMBINED
   38  K      1 ROUTING                               2       2       1
   39  K1    RESERVOIR  ROUTING  FOR  MASTERS  LAKE
   40  Y                                     1       1
   41  Y1     1                                              -1001.67      -1
   42  Y41001.7 1002.00 1003.00 1004.00 1005.00 1006.00 1007.00 1008.00 1008.50 1009.00
   43  Y41009.5 1010.00 1010.50 1011.00 1012.00 1013.00 1014.00
   44  Y5     0     .83   11.76   30.74   46.04   57.25   66.61   80.98  124.08  223.69
   45  Y5360.03  690.21 1417.21 2153.37 5074.48 9911.2516026.37
   46  $S     0   11.72   48.52   87.24  127.88  170.44  214.92  261.32  285.24  309.64
   47  $S334.52  359.88  385.72  412.04  466.12  522.12  580.04
   48  $E1001.7 1002.00 1003.00 1004.00 1005.00 1006.00 1007.00 1008.00 1008.50 1009.00
   49  $E1009.5 1010.00 1010.50 1011.00 1012.00 1013.00 1014.00
   50  $$1001.7
   51  $D1009.8
   52  K     99
```

COMPUTER INPUT DATA

OVN

SUB-AREA RUNOFF COMPUTATION

SUBAREA RUNOFF FOR MASTERS LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW	0	-0	-0	-0	3	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	3.30	-0.00	3.30	1.00	-0.000	-0	1	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
-0.00	26.00	100.00	120.00	130.00	-0.00	-0.00	-0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.00	-0.00	1.00	-0.00	-0.00	1.00	-1.00	-83.00	-0.00	.04

CURVE NO = -83.00 WETNESS = -1.00 EFFECT CN = 83.00

UNIT HYDROGRAPH DATA

TC= -0.00 LAG= .75

RECESSION DATA

STRTQ= 6.60 QRCSN= -.10 RTIOR= 3.00

UNIT HYDROGRAPH 47 END OF PERIOD ORDINATES, TC= -0.00 HOURS, LAG= .75 VOL= 1.00

68.	221.	421.	693.	1048.	1432.	1735.	1926.	2005.	2005.
1926.	1785.	1623.	1424.	1180.	959.	801.	672.	564.	487.
411.	347.	288.	245.	206.	174.	146.	123.	103.	87.
74.	62.	53.	44.	37.	31.	26.	22.	20.	17.
15.	12.	10.	7.	5.	3.	1.			

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	6.	1.01	12.05	145	.22	.20	.01	1704.
1.01	.10	2	.01	.00	.01	5.	1.01	12.10	146	.22	.20	.01	1737.
1.01	.15	3	.01	.00	.01	5.	1.01	12.15	147	.22	.20	.01	1798.
1.01	.20	4	.01	.00	.01	5.	1.01	12.20	148	.22	.20	.01	1895.
1.01	.25	5	.01	.00	.01	5.	1.01	12.25	149	.22	.21	.01	2040.
1.01	.30	6	.01	.00	.01	6.	1.01	12.30	150	.22	.21	.01	2238.
1.01	.35	7	.01	.00	.01	6.	1.01	12.35	151	.22	.21	.01	2478.
1.01	.40	8	.01	.00	.01	7.	1.01	12.40	152	.22	.21	.01	2744.
1.01	.45	9	.01	.00	.01	8.	1.01	12.45	153	.22	.21	.01	3022.
1.01	.50	10	.01	.00	.01	9.	1.01	12.50	154	.22	.21	.01	3301.
1.01	.55	11	.01	.00	.01	10.	1.01	12.55	155	.22	.21	.01	3570.
1.01	1.00	12	.01	.00	.01	11.	1.01	13.00	156	.22	.21	.01	3821.
1.01	1.05	13	.01	.00	.01	11.	1.01	13.05	157	.26	.25	.01	4053.
1.01	1.10	14	.01	.00	.01	12.	1.01	13.10	158	.26	.25	.01	4265.
1.01	1.15	15	.01	.00	.01	13.	1.01	13.15	159	.26	.25	.01	4452.
1.01	1.20	16	.01	.00	.01	13.	1.01	13.20	160	.26	.25	.01	4621.
1.01	1.25	17	.01	.00	.01	13.	1.01	13.25	161	.26	.25	.01	4784.
1.01	1.30	18	.01	.00	.01	14.	1.01	13.30	162	.26	.25	.01	4945.
1.01	1.35	19	.01	.00	.01	14.	1.01	13.35	163	.26	.25	.01	5104.
1.01	1.40	20	.01	.00	.01	14.	1.01	13.40	164	.26	.25	.01	5260.
1.01	1.45	21	.01	.00	.01	14.	1.01	13.45	165	.26	.25	.01	5410.
1.01	1.50	22	.01	.00	.01	14.	1.01	13.50	166	.26	.25	.01	5551.
1.01	1.55	23	.01	.00	.01	14.	1.01	13.55	167	.26	.25	.01	5680.
1.01	2.00	24	.01	.00	.01	14.	1.01	14.00	168	.26	.25	.01	5797.

INPUT UNIT HYDROGRAPH

1.01	2.05	25	.01	.00	.01	15.	1.01	14.05	169	.32	.32	.01	5907.
1.01	2.10	26	.01	.00	.01	15.	1.01	14.10	170	.32	.32	.01	6013.
1.01	2.15	27	.01	.00	.01	15.	1.01	14.15	171	.32	.32	.01	6117.
1.01	2.20	28	.01	.00	.01	15.	1.01	14.20	172	.32	.32	.01	6227.
1.01	2.25	29	.01	.00	.01	15.	1.01	14.25	173	.32	.32	.01	6349.
1.01	2.30	30	.01	.00	.01	15.	1.01	14.30	174	.32	.32	.01	6488.
1.01	2.35	31	.01	.00	.01	15.	1.01	14.35	175	.32	.32	.01	6640.
1.01	2.40	32	.01	.00	.01	15.	1.01	14.40	176	.32	.32	.01	6799.
1.01	2.45	33	.01	.00	.01	15.	1.01	14.45	177	.32	.32	.00	6958.
1.01	2.50	34	.01	.00	.01	16.	1.01	14.50	178	.32	.32	.00	7113.
1.01	2.55	35	.01	.00	.01	17.	1.01	14.55	179	.32	.32	.00	7260.
1.01	3.00	36	.01	.00	.01	18.	1.01	15.00	180	.32	.32	.00	7395.
1.01	3.05	37	.01	.00	.01	19.	1.01	15.05	181	.20	.20	.00	7509.
1.01	3.10	38	.01	.00	.01	21.	1.01	15.10	182	.40	.39	.00	7602.
1.01	3.15	39	.01	.00	.01	23.	1.01	15.15	183	.40	.39	.00	7682.
1.01	3.20	40	.01	.00	.01	26.	1.01	15.20	184	.59	.59	.01	7765.
1.01	3.25	41	.01	.00	.01	28.	1.01	15.25	185	.69	.68	.01	7882.
1.01	3.30	42	.01	.00	.01	31.	1.01	15.30	186	1.68	1.66	.02	8130.
1.01	3.35	43	.01	.00	.01	35.	1.01	15.35	187	2.77	2.74	.02	8703.
1.01	3.40	44	.01	.00	.01	38.	1.01	15.40	188	1.09	1.08	.01	9650.
1.01	3.45	45	.01	.00	.01	42.	1.01	15.45	189	.69	.69	.00	10930.
1.01	3.50	46	.01	.00	.01	45.	1.01	15.50	190	.59	.59	.00	12558.
1.01	3.55	47	.01	.00	.01	49.	1.01	15.55	191	.40	.39	.00	14460.
1.01	4.00	48	.01	.00	.01	52.	1.01	16.00	192	.40	.39	.00	16358.
1.01	4.05	49	.01	.00	.01	56.	1.01	16.05	193	.30	.30	.00	17917.
1.01	4.10	50	.01	.00	.01	60.	1.01	16.10	194	.30	.30	.00	18979.
1.01	4.15	51	.01	.00	.01	64.	1.01	16.15	195	.30	.30	.00	19519.
1.01	4.20	52	.01	.00	.01	67.	1.01	16.20	196	.30	.30	.00	19577.
1.01	4.25	53	.01	.00	.01	71.	1.01	16.25	197	.30	.30	.00	19190.
1.01	4.30	54	.01	.00	.01	75.	1.01	16.30	198	.30	.30	.00	18461.
1.01	4.35	55	.01	.00	.01	78.	1.01	16.35	199	.30	.30	.00	17503.
1.01	4.40	56	.01	.00	.01	82.	1.01	16.40	200	.30	.30	.00	16342.
1.01	4.45	57	.01	.00	.01	85.	1.01	16.45	201	.30	.30	.00	15071.
1.01	4.50	58	.01	.00	.01	89.	1.01	16.50	202	.30	.30	.00	13893.
1.01	4.55	59	.01	.01	.01	92.	1.01	16.55	203	.30	.30	.00	12908.
1.01	5.00	60	.01	.01	.01	95.	1.01	17.00	204	.30	.30	.00	12075.
1.01	5.05	61	.01	.01	.01	99.	1.01	17.05	205	.24	.24	.00	11385.
1.01	5.10	62	.01	.01	.01	102.	1.01	17.10	206	.24	.24	.00	10810.
1.01	5.15	63	.01	.01	.01	105.	1.01	17.15	207	.24	.24	.00	10298.
1.01	5.20	64	.01	.01	.01	108.	1.01	17.20	208	.24	.24	.00	9840.
1.01	5.25	65	.01	.01	.01	111.	1.01	17.25	209	.24	.24	.00	9420.
1.01	5.30	66	.01	.01	.01	114.	1.01	17.30	210	.24	.24	.00	9038.
1.01	5.35	67	.01	.01	.01	117.	1.01	17.35	211	.24	.24	.00	8678.
1.01	5.40	68	.01	.01	.01	120.	1.01	17.40	212	.24	.24	.00	8345.
1.01	5.45	69	.01	.01	.01	123.	1.01	17.45	213	.24	.24	.00	8037.
1.01	5.50	70	.01	.01	.01	126.	1.01	17.50	214	.24	.24	.00	7758.
1.01	5.55	71	.01	.01	.01	129.	1.01	17.55	215	.24	.24	.00	7508.
1.01	6.00	72	.01	.01	.01	132.	1.01	18.00	216	.24	.24	.00	7289.
1.01	6.05	73	.07	.03	.04	136.	1.01	18.05	217	.02	.02	.00	7081.
1.01	6.10	74	.07	.03	.04	145.	1.01	18.10	218	.02	.02	.00	6868.
1.01	6.15	75	.07	.04	.04	159.	1.01	18.15	219	.02	.02	.00	6638.
1.01	6.20	76	.07	.04	.03	181.	1.01	18.20	220	.02	.02	.00	6374.
1.01	6.25	77	.07	.04	.03	214.	1.01	18.25	221	.02	.02	.00	6051.
1.01	6.30	78	.07	.04	.03	259.	1.01	18.30	222	.02	.02	.00	5661.
1.01	6.35	79	.07	.04	.03	314.	1.01	18.35	223	.02	.02	.00	5219.
1.01	6.40	80	.07	.04	.03	377.	1.01	18.40	224	.02	.02	.00	4747.
1.01	6.45	81	.07	.05	.03	445.	1.01	18.45	225	.02	.02	.00	4268.
1.01	6.50	82	.07	.05	.03	515.	1.01	18.50	226	.02	.02	.00	3795.
1.01	6.55	83	.07	.05	.02	587.	1.01	18.55	227	.02	.02	.00	3344.
1.01	7.00	84	.07	.05	.02	657.	1.01	19.00	228	.02	.02	.00	2927.
1.01	7.05	85	.07	.05	.02	724.	1.01	19.05	229	.02	.02	.00	2549.
1.01	7.10	86	.07	.05	.02	788.	1.01	19.10	230	.02	.02	.00	2217.
1.01	7.15	87	.07	.05	.02	847.	1.01	19.15	231	.02	.02	.00	1944.
1.01	7.20	88	.07	.05	.02	900.	1.01	19.20	232	.02	.02	.00	1742.
1.01	7.25	89	.07	.05	.02	949.	1.01	19.25	233	.02	.02	.00	1561.
1.01	7.30	90	.07	.05	.02	994.	1.01	19.30	234	.02	.02	.00	1398.

INPUT UNIT HYDROGRAPH

1.01	7.35	91	.07	.06	.02	1034.	1.01	19.35	227	.02	.02	.00	1053.
1.01	7.40	92	.07	.06	.02	1072.	1.01	19.40	228	.02	.02	.00	1027.
1.01	7.45	93	.07	.06	.02	1111.	1.01	19.45	237	.02	.02	.00	1034.
1.01	7.50	94	.07	.06	.02	1145.	1.01	19.50	238	.02	.02	.00	956.
1.01	7.55	95	.07	.06	.02	1177.	1.01	19.55	239	.02	.02	.00	891.
1.01	8.00	96	.07	.06	.02	1207.	1.01	20.00	240	.02	.02	.00	836.
1.01	8.05	97	.07	.06	.01	1234.	1.01	20.05	241	.02	.02	.00	790.
1.01	8.10	98	.07	.06	.01	1260.	1.01	20.10	242	.02	.02	.00	751.
1.01	8.15	99	.07	.06	.01	1284.	1.01	20.15	243	.02	.02	.00	718.
1.01	8.20	100	.07	.06	.01	1307.	1.01	20.20	244	.02	.02	.00	691.
1.01	8.25	101	.07	.06	.01	1328.	1.01	20.25	245	.02	.02	.00	667.
1.01	8.30	102	.07	.06	.01	1348.	1.01	20.30	246	.02	.02	.00	648.
1.01	8.35	103	.07	.06	.01	1367.	1.01	20.35	247	.02	.02	.00	631.
1.01	8.40	104	.07	.06	.01	1385.	1.01	20.40	248	.02	.02	.00	618.
1.01	8.45	105	.07	.06	.01	1402.	1.01	20.45	249	.02	.02	.00	606.
1.01	8.50	106	.07	.06	.01	1418.	1.01	20.50	250	.02	.02	.00	596.
1.01	8.55	107	.07	.06	.01	1433.	1.01	20.55	251	.02	.02	.00	588.
1.01	9.00	108	.07	.06	.01	1447.	1.01	21.00	252	.02	.02	.00	581.
1.01	9.05	109	.07	.06	.01	1461.	1.01	21.05	253	.02	.02	.00	576.
1.01	9.10	110	.07	.06	.01	1474.	1.01	21.10	254	.02	.02	.00	571.
1.01	9.15	111	.07	.06	.01	1486.	1.01	21.15	255	.02	.02	.00	567.
1.01	9.20	112	.07	.06	.01	1497.	1.01	21.20	256	.02	.02	.00	563.
1.01	9.25	113	.07	.06	.01	1508.	1.01	21.25	257	.02	.02	.00	560.
1.01	9.30	114	.07	.06	.01	1519.	1.01	21.30	258	.02	.02	.00	557.
1.01	9.35	115	.07	.06	.01	1529.	1.01	21.35	259	.02	.02	.00	555.
1.01	9.40	116	.07	.06	.01	1538.	1.01	21.40	260	.02	.02	.00	554.
1.01	9.45	117	.07	.06	.01	1548.	1.01	21.45	261	.02	.02	.00	552.
1.01	9.50	118	.07	.06	.01	1556.	1.01	21.50	262	.02	.02	.00	552.
1.01	9.55	119	.07	.06	.01	1564.	1.01	21.55	263	.02	.02	.00	552.
1.01	10.00	120	.07	.06	.01	1572.	1.01	22.00	264	.02	.02	.00	552.
1.01	10.05	121	.07	.06	.01	1580.	1.01	22.05	265	.02	.02	.00	552.
1.01	10.10	122	.07	.06	.01	1587.	1.01	22.10	266	.02	.02	.00	552.
1.01	10.15	123	.07	.06	.01	1594.	1.01	22.15	267	.02	.02	.00	552.
1.01	10.20	124	.07	.07	.01	1600.	1.01	22.20	268	.02	.02	.00	552.
1.01	10.25	125	.07	.07	.01	1607.	1.01	22.25	269	.02	.02	.00	552.
1.01	10.30	126	.07	.07	.01	1613.	1.01	22.30	270	.02	.02	.00	552.
1.01	10.35	127	.07	.07	.01	1619.	1.01	22.35	271	.02	.02	.00	552.
1.01	10.40	128	.07	.07	.01	1624.	1.01	22.40	272	.02	.02	.00	552.
1.01	10.45	129	.07	.07	.01	1630.	1.01	22.45	273	.02	.02	.00	552.
1.01	10.50	130	.07	.07	.01	1635.	1.01	22.50	274	.02	.02	.00	552.
1.01	10.55	131	.07	.07	.01	1640.	1.01	22.55	275	.02	.02	.00	552.
1.01	11.00	132	.07	.07	.01	1645.	1.01	23.00	276	.02	.02	.00	552.
1.01	11.05	133	.07	.07	.01	1650.	1.01	23.05	277	.02	.02	.00	552.
1.01	11.10	134	.07	.07	.01	1654.	1.01	23.10	278	.02	.02	.00	552.
1.01	11.15	135	.07	.07	.01	1659.	1.01	23.15	279	.02	.02	.00	552.
1.01	11.20	136	.07	.07	.01	1663.	1.01	23.20	280	.02	.02	.00	552.
1.01	11.25	137	.07	.07	.01	1667.	1.01	23.25	281	.02	.02	.00	552.
1.01	11.30	138	.07	.07	.01	1671.	1.01	23.30	282	.02	.02	.00	552.
1.01	11.35	139	.07	.07	.01	1675.	1.01	23.35	283	.02	.02	.00	552.
1.01	11.40	140	.07	.07	.01	1678.	1.01	23.40	284	.02	.02	.00	552.
1.01	11.45	141	.07	.07	.01	1682.	1.01	23.45	285	.02	.02	.00	552.
1.01	11.50	142	.07	.07	.00	1685.	1.01	23.50	286	.02	.02	.00	552.
1.01	11.55	143	.07	.07	.00	1689.	1.01	23.55	287	.02	.02	.00	552.
1.01	12.00	144	.07	.07	.00	1692.	1.02	0.00	288	.02	.02	.00	552.
									SUM	33.80	31.55	2.25	799915.
										(859.)	(801.)	(57.)	(22651.87)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19577.	8781.	2776.	2776.	799630.
CMS	554.	249.	79.	79.	22643.
INCHES		24.75	31.31	31.31	31.31
MM		628.72	795.18	795.18	795.18
AC-FT		4354.	5507.	5507.	5507.
THOUS CU M		5371.	6793.	6793.	6793.

INPUT UNIT HYDROGRAPH

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1001.67	1001.70	1009.80
STORAGE	0.	0.	350.
OUTFLOW	0.	0.	558.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1010.17	.37	369.	937.	2.33	17.50	0.00
.15	1011.09	1.29	417.	2428.	3.67	16.67	0.00
.20	1011.53	1.73	441.	3700.	4.83	16.58	0.00
.30	1012.16	2.36	475.	5853.	6.92	16.50	0.00
.50	1013.00	3.20	522.	10560.	11.25	16.42	0.00
1.00	1015.56	5.76	670.	24549.	14.00	16.42	0.00

COMPUTED SUMMARY ANALYSIS